

REMARKS

Claims 1 through 12 are pending in the subject application. Claims 1-12 stand rejected under 35 U.S.C. 103(a). Claims 8 and 9 have been amended.

The Applicants appreciate the Examiner's thorough examination of the subject application. However, the Applicants respectfully request reconsideration of the subject application based on the above amendments and the following remarks.

35 U.S.C. § 103(a) REJECTION

The Examiner rejected claims 1, 2, and 12 under 35 USC 103(a) as being unpatentable over admitted prior art in view of U.S. Patent Number 5,537,235 to Ishihara, et al. ("Ishihara" or the "Ishihara Reference") further in view of U.S. Patent Number 4,526,818 to Hoshikawa, et al. ("Hoshikawa" or the "Hoshikawa Reference"); claims 3-7 and 10-11 under 35 USC 103(a) as being unpatentable over admitted prior art in view of Ishihara, Hoshikawa, and further in view of U.S. Patent Number 6,104,467 to Nakahara, et al. ("Nakahara" or the "Nakahara Reference"); and claims 8-9 under 35 USC 103(a) as being unpatenable over Ishihara in view of Hoshikawa, further in view of Nakahara, and further in view of U.S. Patent Number 6,327,011 to Kim ("Kim" or the "Kim Reference"). The Applicants respectfully traverse these rejections for the reasons provided in greater detail below.

Claims 1, 2, and 12

With respect to claims 1, 2, and 12, the Examiner asserts that the prior art discloses all of the structural elements of the invention as claimed except that it does not disclose that a cell gap is formed so as to gradually increase from a center to an end of a display area at room temperature. According to the Examiner, the Ishihara reference discloses a liquid crystal display ("LCD") device having a gap between

electrodes 32a and 32b at an edge portion 52 of a displaying portion 50 that increases gradually to a peripheral portion 53 to prevent development of unevenness in display at the edge portion 55 due to temperature increases but, as the Examiner freely admits, Ishihara does not teach a "gradually increase from a center to an end of the display area;" which feature, according to the Examiner, is taught by Hoshikawa. The Applicants respectfully disagree.

The present invention provides an LCD device that prevents irregular display color, which can result at relatively high operating temperatures, e.g., around 60 to 70 degrees Centigrade (°C), by forming a cell gap that, at room temperature, gradually increases from the center to an end of a display area, which is to say that, at room temperature, the cell gap at the center of the LCD cell is smaller than the cell gap at the ends of the LCD cell. See, e.g., Application, page 6, lines 16-18 and page 12, lines 2-7. As a result, this arrangement reduces the cell gap difference between the center gap and the end gaps, which can cause irregular display color at higher temperatures. As a result, the present invention can account for the difference in thermal expansion of the liquid crystal material and the sealing material. See, e.g., Id., page 6, line 22 to page 7, line 1.

In sharp contrast, the Ishihara reference teaches an LCD device that is structured and arranged such that the gap gradually increases from an edge portions 67 or 52 to a peripheral portions 68 or 53. See, e.g., Ishihara, col. 7, lines 19-23 and lines 32-37. Further, referring to FIGs, 3A and 4A, the gap at the middle portion 66 or 51 remains constant until the edge portion 67 or 52 is reached. There is nothing in the Ishihara reference that teaches, mentions or suggests gradually increasing the gap distance from the center of the LCD device to the peripheral portion.

Furthermore, according to Ishihara, backlighting causes the difference in temperatures between the middle portion and the peripheral portion of a display area, resulting in the threshold voltages of respective pixels not being uniform. See, e.g.,

Id., col. 2, lines 1-12 and col. 8, lines 18-29. However, the difference in temperatures brought into question in Ishihara is partial high temperature of the display device. Hence, Ishihara does not mention the occurrence of an irregular display color due to the expansion of the middle portion when generally operated at high temperatures, which is the problem solved by the present invention. As a result, when an Ishihara display device is operated at temperatures of 60-70°, the middle portion expands, causing an irregular display color as shown in FIG. 14 of the present invention.

Moreover, Ishihara approaches the problem of high temperatures in the peripheral portion sorely from the perspective of the variation of threshold voltages. The irregularity of coefficients of thermal expansion is not taught or mentioned at all. Had Ishihara considered the irregularity of coefficients of thermal expansion, the size of the cell gap at the peripheral portion should have been reduced rather than increased. For this reason, and contrary to the Examiner's assertion, the Applicants maintain that, even if Ishihara is combined with the description of conventional art concerning the difference of coefficients of thermal expansion between materials, see, e.g., Specification, page 4, line 18 to page 6, line 4, one of ordinary skill in the art could NOT arrive at the present invention.

The Hoshikawa reference cannot make up for the deficiency of Ishihara. Indeed, Hoshikawa teaches LCD panels fabricated using flexible substrates comprising a polarizing film sandwiched between a pair of plastic films, wherein at least one of the plastic films has a curvature. See, e.g., Hoshikawa, col. 8, lines 27-32. Curvature of the flexible substrates push against rigid spacers 5 in the cell to provide "a uniform cell thickness over the entire surface area of the cell." Id., col. 5, lines 14-21; col. 6, lines 64-68; col. 7, lines 42-47; and col. 7, line 67 to col. 8, line 2. Accordingly, because the gap is uniform, at higher temperatures, display unevenness would develop. Thus, the Applicants respectfully assert that, Hoshikawa merely teaches a flexible substrate as an alternative to glass substrates and, moreover, that Hoshikawa expressly teaches

away from providing a cell gap that increases gradually from the center to the end of the display area. As a result, one skilled in the art would not have found the teachings of Hoshikawa particularly relevant. Nor would one skilled in the art have been motivated to apply the teachings of Hoshikawa to produce the present invention.

FIG. 8 of Hoshikawa illustrates a process to assemble an upper substrate 110 and a lower substrate 220 with the respective convex surfaces facing each other. However, as FIG. 9 (illustrating the finished product) as well as FIGs. 1-6 show, the cell gap is uniform in the finished product and there is no gradual increase. This is because, first, Hoshikawa teaches providing a uniform cell gap and, second, in Hoshikawa, at least either one of the substrates is caused to curve in the manufacturing process, in order to apply pressure on the middle portion of the panel after the assembly. Thus, use of rigid spacers eliminates the curve so that the substrate is flat after the assembly. See, e.g.; Id., col. 5, lines 14-19 and col. 6, lines 35-40. The arrangement disclosed by Hoshikawa et al. is totally different from the present invention.

Further, Hoshikawa supposes that working temperatures are in the range of 0-40°C, thereby not considering the operation at high temperatures of 60-70°C as in the present application. See, e.g., Id., col. 5, line 65 to col. 6, line 2.

Moreover, it is understood that the curved substrate of Hoshikawa cannot achieve the objective of the present application. That is to say, in Hoshikawa, the substrate is caused to curve by laminating plastic films 13 and 23 having low thermal expansion coefficients and plastic films 12 and 22 having high thermal expansion coefficients, and the plastic films 13 and 23 are provided so as to touch a liquid crystal layer 6. See, e.g., Id., col. 6, lines 19-40. Thus, when the liquid crystal display panel is used at high temperatures, it is obvious that the films 12 and 22 having high thermal expansion coefficients greatly expand so that the pressure on the middle

portion of the panel caused by the curved substrates 1 and 2 is removed, and consequently the middle portion expands upward and downward.

Accordingly, the Applicants respectfully assert that, claims 1, 2, and 12 are not made obvious by the admitted prior art in view of the Ishihara and Hoshikawa references.

Claims 3-7 and 10-11

The Nakahara reference also cannot make up for the deficiencies of the Ishihara and Hoshikawa references. Indeed, the Nakahara reference neither teaches, mentions nor suggests resolving irregular display color of an LCD device resulting from a change in an atmospheric temperature by means of controlling the cell gap distance, and, more particularly, by forming a cell gap between a pair of insulating substrates so as to increase gradually from the center to the end of the display area at room temperature. Accordingly, the Applicants respectfully assert that, claims 3-7 and 10 are not made obvious by the combination of the three references.

Claims 8-9

Similarly, the Kim reference cannot make up for the deficiencies of the Ishihara, Hoshikawa, and Nakahara references. Indeed, the Kim reference neither teaches, mentions nor suggests resolving irregular display color of an LCD device resulting from a change in an atmospheric temperature by means of controlling the cell gap, and, more particularly, by forming a cell gap between the pair of insulating substrates so as to increase gradually from the center to the end of the display area at room temperature. Accordingly, the Applicants respectfully assert that, claims 8-9 are not made obvious by the combination of the four references.

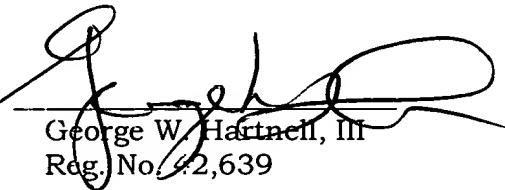
In short, it is respectfully submitted that, claims 1-12 are not made obvious any of the cited references, and further, satisfy all of the requirements of 35 U.S.C. 100, et seq., especially § 103(a). Accordingly, claims 1-12 are allowable. Moreover, it is respectfully submitted that the subject application is in condition for allowance. Early and favorable action is requested.

The Applicants believe that no additional fee is required for consideration of the within Response. However, if for any reason the fee paid is inadequate or credit is owed for any excess fee paid, you are hereby authorized and requested to charge Deposit Account No. **04-1105**.

Respectfully submitted,

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ANNEX TO RESPONSE TO OFFICE ACTION
INCLUDING MARKED-UP VERSION OF AMENDED CLAIMS

Please **replace** the paragraph beginning at line 21, page 18 and ending at line 4, page 19 with the following:

Fig. 98 shows measurement results of cell gap fluctuations relative to atmospheric temperature fluctuations, regarding the center and a part around the seal of the liquid crystal cell 6. The higher the atmospheric temperature is, the liquid crystal 5 expands further. The cell gap increases both in the center and around the seal. Fig. 2(c) is a sectional view of the liquid crystal cell 6 when an atmospheric temperature is 25°C (room temperature) and 70°C (high temperature).

IN THE CLAIMS

Please **amend** the following claims as shown:

8. (Amended) The liquid crystal display device as defined in claim 1, wherein each of said pair of said insulating substrates is a glass substrate having a thickness of 0.55mm or less.

9. (Amended) The liquid crystal display device as defined in claim 1, wherein each of said pair of said insulating substrates is a plastic substrate having a thickness of 0.55mm or less.